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Customer Services Engineering

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AERIAL PLANT

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10.01 PLANNING AND DESIGN GUIDELINE--PRACTICE 919-120-100

* Consider aerial design only if buried design is significantly more expensive or is not feasible.

* Select permanent locations for pole lines considering:
* future road widening or realignment
* expansion of other utilities

* special problems such as road, railway, and power line crossings
* safety and convenience of workers and the general public.

* Obtain necessary permits and easements for:
* building and maintaining pole lines on private property and public right-of-way
* crossing railroads
* crossing over navigable waterways

* Coordinate with other utilities with respect to:
* possible joint use
* minimizing inductive interference.

* Design pole line for ultimate needs, considering pole line classification, storm loading, and clearance requirements.

* Use the most economical span length within the constraints imposed by the design guidelines herein.

* When adding cable to an existing line or when establishing a joint use line, check that the pole strength and clearances are adequate.

* Use self-supporting cable rather than lashed cable if it is available in the required size and, if (1) there is no existing strand, or (2) new cable cannot be lashed to an existing cable.

10.02 POLES

A. POLE CLASSES--PRACTICES 621-020-111, 919-120-700

The strength of a pole is indicated by a class number, with the strongest rated at 1 and the least strong rated at 10. All poles of the same class, regardless of length and timber species, must be able to withstand the same horizontal load, applied 2 feet from the top of the pole. The minimum breaking loads are given below. These loads are computed with the assumption that the break would occur at the ground line.

The class of pole for a given installation is based on its design load not exceeding a percentage of the breaking strength. That percentage is determined by the pole line class (see Section 10.03.A.).

Characteristics of Poles

Pole Class	Breaking Load	Longest Available Pole (Ft.)	Weight of Longest

	2 Ft. from Top (Lb.)		Pole (Lb.) (Note)
1	4500	125*	10850
2	3700	125*	9510
3	3000	110*	6610
4	2400	80*	3430
5	1900	70*	2400
6	1500	60	1620
7	1200	50	1040
8		This is not a standard class	
9	740	30	340
10	370	25	210

Note: Weight is for the heaviest species (SP); the lightest species (WC) is 30 to 40 percent lighter.

*The longest JP, LP, or NP pole is 60 feet.

B. MARKINGS ON POLES AND STUBS--PRACTICES 621-02~013, 919-120~00

Since 1974, poles and stubs have been marked as illustrated on figure below. Between 1964 and 1974, the markings were the same except that the AT and AT-R designations were not used. Prior to 1964, only poles (not stubs) were marked. Codes used in these markings are listed below.

Fig. 1--Codes Used in Markings on Poles (<--Click here to view figure.)

Timber Species Codes

WC	Western Red Cedar
WP	Ponderosa Pine
JP	Jack Pine
LP	Lodgepole Pine
NP	Red Pine
DF	Douglas Fir
SP	Southern Pine
WL	Western Larch

Preservative Treatment Codes		Used on Above Timber Species
A	Creosote Pentachlorophenol	SP
C	Creosote*	SP
G	Pentachlorophenol in LP Gas (Cellon Process)	WP, LP, DF, SP

P	Pentachlorophenol in Petroleum	All
S	CHEMONITE**	(Discontinued code)
SB	Ammoniacal Copper Arsenite (ACA-CHEMONITE)	All
SC	Chromated Copper Arsenate (CCA) Type A	All
SK	CCA Type C	All

*Furnished only on specific authorization of operating company.
**Registered trademark of the l.H. Baxter Company.
For a description of preservative treatments, see Practice 919-120-400.

In 1946-47, poles treated with a preservative other than creosote were marked with symbols that are now obsolete and do not correspond to the codes listed above.

10.03 POLE LINE DESIGN

A. POLE LINE CLASSIFICATION--PRACTICE 919-120-200

Pole lines are classified according to their service value. Those carrying more critical services are designed with a higher strength-to-load ratio. Classifications are as follows:

Class of Line		Design Stress for Transverse Storm Loading (% of Max Strength) at Installation	Design Stress for Transverse Storm Loading (% of Max Strength) at Replacement
AA	Analog or digital carrier and any broadband technology	25	37.5
JB	Both communication circuits and power circuits of NESC Grade B construction		
A	100-180 toll circuits or 1000-1800 exchange pairs. Priority II defense circuits		
JC	Both communication circuits and power circuits of NESC Grade		

	C construction		
B	Fewer than 100 toll circuits or 400-1000 exchange pairs. Priority III defense circuits		
C	25-400 exchange pairs only		
R	Fewer than 25 exchange pairs, one 6M or lesser stand, two multiple line wires, or one crossarm of open wire		

Note: One toll circuit is equivalent to ten exchange pairs. For broadband circuits, 4 kHz is equivalent to one toll circuit, e.g., one 50-kHz circuit equals 12-1/2 toll circuits.

*37.5 at railroad crossings.

B. STORM LOADING AREAS--PRACTICE 919-120-200, NESC SECTION 25

The National Electric Safety code (NESC) divides the contiguous United States into three storm loading areas based on the frequency, severity, and damaging effects of ice and wind storms. These areas and the design load data for each are defined below.

Note: All of the NYNEX Operating Companies are included in the Heavy Storm Loading Area.

Fig. 2--Storm Loading Areas and Design Load Data (<--Click here to view figure.)

Pole Line Design Loads

Storm Loading Area	Radial Thickness* of Ice Coating on Conductors and Messengers (In.)	Transverse Wind Pressure (Lb./Ft.*) of Projected Area	Minimum Temperature (F)
Heavy	1/2	4	0
Medium	1/4	4	15
Light	None	9	30

* When computing transverse wind loading, ignore ice coating on poles and towers.

C. POLE LOADING--PRACTICE 919-120-200, -700

Poles are subjected to three types of loading:

(1) Transverse storm loading due to wind pressure on the attachments and on the aboveground portion of the pole itself. (In heavy and medium storm

loading areas, loading includes the wind force on the ice-coated attachments but not on the ice coating of the pole itself.)

(2) Vertical loading due to the weight of the attachments and, on guyed poles, the vertical component of the tensions in the guys. (In heavy and medium storm loading areas, loading includes the weight of the ice coating on the attachments.)

(3) Bending moments due to eccentric loads or to unbalanced tensions at unguyed corners and dead ends.

For most poles, transverse storm loading determines the required pole class. Vertical loads may be controlling factors for poles carrying large cables or transformers, while bending moments are usually controlling at unguyed corners and dead ends.

Transverse Storm Loading--Practice 919-120-700

To determine transverse loading on the pole:

* Find the storm load of each pole attachment.

* Translate that load to an equivalent load 2 feet from the top of the pole.

Storm loads for some common attachments are given below.

TRANSVERSE STORM LOADS FOR POWER ATTACHMENTS

Practice 919-120-200

Power Company Attachment	Diameter Without Ice (In.)	Storm Loading Area: Heavy	Medium	Light
		Transverse Storm Load (Lb/Ft)		
Covered Wire: #8 AWG or smaller	0.26	0.42	0.25	0.20
#6 AWG	0.32	0.44	0.27	0.24
#4 AWG	0.38	0.46	0.29	0.29
#0000 AWG	0.65	0.55	0.38	0.49
500,000 circular mils	1.11	0.70	0.54	0.83
1,000,000 circular mils	1.53	0.84	0.68	1.15
2,000,000 circular mils	2.15	1.05	0.88	1.61
Power Cable on Strand	2.56	1.19	1.01	1.92
Spacer Cables: Consider each conductor separately.				
Suspension wire extending transversely between two poles and supporting trolley wires --.				
One contact wire		2.21	2.01	1.95
Two contact wires		4.42	4.02	3.90
Four contact wires		6.62	6.03	5.85
Bracket and one trolley contact wire on one side of pole line		0.74	0.40	0.62
Brackets and two trolley contact wires, one on each side of pole line		1.10	0.60	0.70
Bracket and two trolley contact wires, over tracks on same side of pole line		1.84	1.21	1.48
Transformers, 37.5 kVA or less		0.37	0.20	0.47
Transformers, over 37.5 kVA		0.37	0.40	0.70
Transverse clearance attachment for service drop above telephone attachments, per wire		0.37	0.40	0.31
Service drops, per unbalanced drop wire		0.37	0.20	0.23
Street lamp supported by mast arm (not bracket)		0.37	0.20	0.23

TRANSVERSE STORM LOADS FOR TELEPHONE ATTACHMENTS

Practice 919-120-200

Telephone Plant Attachment		Approx. Diameter Without Ice (In.)	Storm Loading Area — Transverse Storm Load (Lb/Ft)		
			Heavy	Medium	Light
Bare Open Wire*: (per wire)	80, 83	0.08	0.36	0.20	0.06
	104, 109	0.10	0.37	0.20	0.08
	128, 134	0.13	0.38	0.21	0.10
	165	0.16	0.39	0.22	0.12
C Drop Wire		0.33	0.44	0.28	0.25
F Drop Wire		0.30	0.43	0.27	0.23
C, E, or F Multiple Drop Wire		0.56	0.52	0.35	0.42
C Rural Wire		0.28	0.43	0.26	0.21
Strand:	2.2M	0.17	0.39	0.22	0.13
	6M	0.31	0.44	0.27	0.23
	6.6M	0.25	0.42	0.25	0.19
	10M	0.37	0.46	0.28	0.28
	16M	0.44	0.48	0.31	0.32
	25M	0.50	0.50	0.33	0.38
Cables (see next page)					
Cable Terminal — 202-pair or less			0.37	0.20	0.31
Cable Terminal — More than 202-pair			0.37	0.20	0.47
Loading Coil Case			0.37	0.20	0.09
Unbalanced Service Drops — Per drop			0.37	0.20	0.16

*In heavy and medium storm loading areas, the larger diameter of ice-covered wires shields adjacent wires. Where there are more than ten wires on a crossarm, at a pin spacing not greater than 15 inches, calculate transverse storm loading using two-thirds the actual number of wires (but not less than ten) to compensate for this shielding effect. This reduction in effective number of wires does not apply at railroad crossings.

Transverse Storm Loads for Telephone Cables

Lashed Cable: Add diameter of cable to diameter of strand. Use this diameter in chart below. Diameters of cables are covered in Section 14.

Self-supporting cable: Add 0.46 inch to cable diameter. Use this diameter in chart below.

Cable in rings: Determine loads for strand and cable separately. Obtain strand load from figure above and chart below.

Fig. 3--Transverse Storm Loads for Power Attachments (<--Click here to view figure.)

Equivalent Transverse Storm Load of Attachments

Convert actual storm load of attachments to equivalent load 2 feet from top of pole by:

$$\text{Equivalent load (lb/ft)} = \frac{\text{Actual load (lb/ft) X Height o}}{\text{Height to 2 ft from top}}$$

D. POLE CLASS BASED ON TRANSVERSE STORM LOADING--PRACTICE 919-120-700

To determine pole class;

(1) Find the combined equivalent storm load per foot of span length at a point 2 feet from the top of the pole for all attachments.

(2) Multiply by the average length of the two adjacent spans to get the total load of attachments.

(3) Using this load, tentatively determine the pole class from the table below (note that the load used does not include the load of the pole itself).

(4) Determine the wind load on this class of pole from table "Wind Moment on Poles" and add to the result of (2) to determine the total storm load.

(5) Using the result of (4), return to the table below and redetermine the pole class.

(6) If (5) results in a different pole class, repeat (4) and (5), using the pole class determined in (5).

(See example below.)

MAXIMUM ALLOWABLE TRANSVERSE STORM LOAD									
*Class of Line	Class of Pole								
	1	2	3	4	5	6	7	9	10
	Transverse storm load (lb) two feet below top of pole								
AA or JB	1125	925	750	600	475	375	300	185	93
A	1800	1480	1200	960	760	600	480	296	148
JC	2250	1850	1500	1200	950	750	600	370	185
B	2700	2220	1800	1440	1140	900	720	444	222
C	3150	2590	2100	1680	1330	1050	840	518	259
R	3600	2960	2400	1920	1520	1200	960	592	296

* Class of pole line, see Page 10-2.

WIND MOMENT ON POLES
[Maximum Equivalent Load 2 Feet From Top (Lb)]

Practice 919-120-700

Timber Species	Length of Pole (Ft)	Class of Pole 1	2	3	4	5	6	7	9	10
		Heavy and Medium Storm Loading Access								
WC, WP, JP, NP, or LP	20	31	29	27	25	23	21	19	17	16
	25	38	36	33	31	28	26	24	21	20
	30	47	44	41	38	35	32	29	27	
	35	56	53	50	46	42	39	35		
	40	67	63	59	55	50	46	42		
	45	79	74	69	64	59	54	49		
	50	87	82	77	71	65	60	54		
SP, DF, or WL	20	30	28	26	24	22	20	18	16	155
	25	37	34	32	30	27	25	23	20	19
	30	46	43	40	37	34	31	28	25	
	35	55	51	48	44	40	37	34		
	40	65	61	57	52	48	44	40		
	45	76	71	66	61	56	52	47		
	50	84	79	73	68	64	57	52		
		Light Storm Loading Area								
WC, WP, JP, NP, or LP	20	69	64	60	55	51	46	42	38	36
	25	86	81	75	70	64	59	53	48	45
	30	106	100	93	86	79	72	66	60	
	35	127	120	112	104	95	87	79		
	40	151	142	133	123	113	104	94		
	45	177	167	156	144	132	122	110		
	50	196	185	172	160	146	135	122		
SP, DF, or WL	20	67	62	58	54	49	45	40	37	35
	25	83	78	72	67	62	56	51	46	44
	30	102	96	89	83	76	70	63	57	
	35	123	115	107	99	91	83	76		
	40	145	137	127	118	109	99	90		
	45	170	160	149	138	127	116	105		
	50	189	178	165	152	144	129	117		

Example of Pole Class Based on Transverse Storm Loading

* Class AA line in the light storm loading area

* 35-foot southern pine pole

* 180- and 220-foot adjacent spans

(1) Assume 1.5 Ib./ft equivalent storm load to attachments.

(2) Total load of attachments = 1.5 (180 + 220! = 300 lb.

(3) Table "Maximum Allowable Transverse Storm Load" above indicates class 7 pole.

(4) Table "Wind Moment on Poles" above indicates 76-lb. wind load on (class 7) pole.
Total load = 76 + 300 = 376 lb.

(5) For a 376-lb load, table "Maximum Allowable Transverse Storm Load" indicates a class 5 pole.

(6) (Repeat 4) Table "Wind Moment on Poles" indicates 91-lb wind load on class 5 pole.

(7) Total load = 91 + 300 = 391 lb.

(8) (Repeat 5) For a 391-lb load, table "Maximum Allowable Transverse Storm Load" above indicates a class 5 pole.

For class of unguyed corner and dead end poles, see Section F.

For class of poles for slack scans see Section F--Depth of Setting Unguyed Corner and Dead-End Poles.

Eccentric Loads--Practice 919-120-700

A bending moment is caused by eccentric loads, such as a cable on an extension arm or a transformer mounted at right angles to the direction of the line. Any such bending moment should be included in the transverse load when determining the pole class. To convert eccentric load to equivalent transverse load 2 feet from top of pole, see below.

Fig. 4--Converting Eccentric Load to Equivalent Transverse Load (<--Click here to view figure.)

The attachment is a conductor subject to ice coating, see Practice 919-370-200 for method of computing weight.

Recommendations:

* When eccentric loads are present, use one class larger pole than the minimum required.

* Guy the poles that have unusually heavy eccentric loads.

Vertical Loading--Practices 919-120-200, -700

When the class of pole is being determined, the vertical load on an unguyed pole due to the weight of its attachments and ice is usually not significant compared to the transverse storm loading. For treatment of unusually heavy attachments, see the referenced practices.

Vertical loading, however, is usually the controlling factor in determining the class of guyed poles. Size poles to withstand the vertical component of the total force of all guys attached to the pole when the guys are stressed to their breaking strength.

The total vertical load depends on the number and size of guys and their lead-to-height ratios. (For the definition of lead and height, see Section 10.04.)
The following table gives the pole class required when all guys are attached 2 feet from the top of the pole and all have approximately the same lead/height ratio. If the guys are attached at a lower point, a lower pole strength is required. For this and other special cases, see the referenced practices.

CLASS OF GUYED POLES OR STUBS FOR VERTICAL LOADING Practice 919-120-700								
Lead/ Height Ratio	Length of Pole (Ft)	Maximum Sum of Guys						
		6.6M	12M	18M	25M	30M	40M	50M
		Class of Pole						
Less Than 1	20	10	9	9	7	6	6	5
	25	9	9	7	6	6	5	5
	30	9	7	7	6	5	5	4
	35	7	7	6	5	5	4	3
	40	7	7	6	5	4	4	3
	45	7	6	5	4	4	3	3
	50	7	6	5	4	4	3	2
	55	6	6	5	4	3	3	2
	60	6	5	4	4	3	2	2
	65	5	5	4	3	3	2	1
	70	5	5	4	3	2	2	1
1 or Greater	20	10	9	9	7	7	6	6
	25	9	9	9	7	6	5	5
	30	9	9	7	7	6	5	5
	35	7	7	7	6	5	5	4
	40	7	7	6	5	5	4	4
	45	7	7	6	5	5	4	3
	50	7	7	6	5	4	3	3
	55	6	6	5	4	4	3	3
	60	6	6	5	4	4	3	2
	65	5	5	5	4	3	2	2
	70	5	5	4	4	3	2	2

E. DEPTH OF SETTING POLES--PRACTICES 919-120-600. -700

Length of Pole (Ft.)	Depth of Set (Ft.) Firm Earth	Dept. of Set (Ft.) Solid Rock
20	4	3
25	5	3
30	5-1/2	3-1/2
35-40	6	4
45	6-1/2	4-1/2
50	7	4-1/2
55	7-1/2	5
60	8	5
65	8-1/2	6

70	9	6
75	9-1/2	6
80	10	7
85	10-1/2	7
90-100	11	7
105-125	12	8

In sloping ground, increase the depth of set on amount A, as shown below.

Fig. 5--Depth of Setting Poles (<--Click here to view figure.)

For depth of setting unguyed corner and dead-end poles, see Section F--Depth of Setting Unguyed Corner and Dead-End Poles.

F. UNGUYED CORNER AND DEAD-END POLES--PRACTICES 919-120-200, -700

Determining Pole Class

Whenever possible, corner and dead-end poles should be guyed or braced. Where this is not practical, determine the pole class base on (1) storm loading, and (2) everyday unbalanced tensions, and use the larger class. Storm loading has two components:

* Transverse loading on the pole and its attachments

* Unbalanced storm-loaded tensions in the wires or strands resulting from the change in direction of pull.

These two components (shown below) have different design safety factors which must be applied to each component separately before they are combined.

Class of* Pole Line	Safety Factor Transverse Loading	Safety Factor Unbalance Tensions
AA or JB	4.0	2.0
A	2.5	1.33
JC	2.0	1.33
B	1.67	1.33
C	1.43	1.0
R	1.25	1.0

* See Section 10.03.A. for class of pole line.

Transverse storm loading is determined as shown above for line poles and is expressed in equivalent load (in pounds) 2 feet from the top of the pole, or at ground line.

$$\text{Equivalent load (lb)} = \frac{\text{[unbalanced tension] X [height of}}{\text{[distance from groun}}$$

Fig. 6--Illustration of Pull on Pole (<--Click here to view figure.)

Convert each unbalanced tension to equivalent load 2 feet from the top of the pole by:

$$\text{Unbalanced tension (lb)} = \frac{\text{[pull (ft)] X [line tension (lb)]}}{50}$$

For line tension, use 60 percent of the breaking strength of the wire or strand. For tension of power attachments, consult the power company. For pull on a pole, see below. Use a pull finder to find the pull on a corner pole (see Practice 621-400-011).

To determine the pole class based on storm loading:

(1) Compute total equivalent load 2 feet from top of pole due to transverse load of all attachments and multiply by the appropriate safety factor from table above.

(2) Compute total equivalent load 2 feet from top of pole due to unbalanced tensions of all wires and cables and multiply by appropriate safety factor from table above.

(3) Add the results of (1) and (2) and determine the pole class from the table in Section 10.02.A.

To determine the pole class based on everyday unbalanced tensions:

(1) Using stringing tension of wire or tension of strand with cable in place, compute unbalanced tension for each wire and cable by the method outlined above for storm-loaded tensions.

(2) Convert to equivalent load 2 feet from top of pole.

(3) Combine equivalent loads for all attachments and find pole class from the chart below. The pole class thus determined will have a safety factor of three and a deflection of not more than 1/2 inch per foot of pole height.

Fig. 7--Chart for Determining Pole Class (<--Click here to view figure.)

Depth Of Setting Unguyed Corner And Dead-End Poles--Practice 919-120-700

Unguyed corner and dead-end poles should be set at a greater-than-normal depth to limit tilting. The depth of set depends on the maximum ground-line moment under storm-loading conditions.

To determine ground-line moment, add the equivalent loads determined in steps (1) and (2) under storm loading above before applying safety factors. Multiply this sum by the distance from ground line to 2 feet below top of pole. The result is the ground-line moment in pound-feet. Recommended setting depths are indicated below.

Frost Depth (Ft)	Corner Pull (Ft)	Maximum Ground-Line Moment (1000 Lb-Ft)								
		20	40	50	70	90	110	130	160	200
		Depth of Pole Set (Ft)								
0 to 1	0-2½	5	5	5½	6	6½	7	7½	8	8½
	2½-5	6½	6½	7	7½	8	8½	9	9½	9½
	5-15	6½	7	7	8	8½	9	9	9½	10
	>15	7	7½	8	8½	9	9½	9½	10	10½
1 to 2	0-2½	5½	5½	6	6½	7	7½	8	8½	9
	2½-5	7	7	7½	8	8	8½	9	9½	9½
	5-15	7	7½	8	8½	9	9½	9½	10	10
	>15	7½	8	8½	9	9	9½	9½	10	10½
2 to 3	0-2½	6	6	6½	7	7½	7½	8	8½	9
	2½-5	7	7½	8	8½	8½	9	9	9½	9½
	5-15	7½	8	8½	8½	9	9½	9½	10	10½
	>15	8	8½	8½	9	9	9½	9½	10	10½

G. SLACK SPAN DESIGN PRACTICES 627-240-225, 919,-120-700

With normal stringing tensions, the unbalanced load on an unguyed dead-end pole may exceed the strength of the largest available pole. This limitation may be overcome by using less-than-normal stringing tension in the dead-end span. Obtain line tension from the table below; then determine pole class from the chart above.

Size of Strand	Stringing Tension (Lb)	Span Length (Ft)	Tension with Cable in Place at 60°F (Lb)					
			Cable Weight (Lb/Ft)					
			0.5	1	2	3	4	5
6M	300	50	510	675	960	1200	1425	
		75	580	800	1160			
		100	645	940	1390			
	500	50	645	800	1080	1320		
		75	720	925	1290			
		100	840	1090				
	800	50	900	1000	1220	1460		
		75	925	1075	1420			
		100	1030	1265				
6.6M	300	50	460	590	845	1065	1265	1430
		75	510	710	1030	1300		
		100	610	875	1255			
	500	50	605	710	935	1150	1345	
		75	660	815	1120	1380		
		100	715	955	1340			
10M	300	50	520	700	1040	1300	1500	
		75	580	850	1250	1400		
		100	670	1025	1450			
	500	50	670	825	1125	1380		
		75	750	970	1350			
		100	840	1150				
	800	50	910	1035	1280			
		75	975	1150	1500			
		100	1050	1310				
16M 25M	Do not use slack span design							

H. PUSH BRACES--PRACTICE 621-205-211

A pole used as push brace should be of the same class as the pole it supports.

10.04 POLE LINE GUYING--PRACTICES 621-400-011, -113

Dead ends and corners in pole lines usually require guying to support the cable or wire facility. The size of the guy is based on the size of the suspension strand or type of wire, the lead and height of the guy, and the pull on the pole.

* Lead and height are defined below.

* If the lead/height ratio is 3/4 or greater, head guys for cables can be the same size as the suspension strand.

* If the lead/height ratio is between 1/2 and 3/4 and only

two or three spans are involved, head guys for cables should be one size larger than the suspension strand.

* For all other guys, use the Guy Rule (Practice 621-400-013) * to determine guy size. Where 6M guy is indicated, 6.6M guy may be used.

* At corner poles use a pull finder to determine the pull on a pole (see Practice 621-400-011).

* If the pull on a corner pole is less than 50 feet, a guy can be placed at a bisecting angle (see Practice 621-400-011).

* If the pull is greater than 50 feet, two head guys are required as shown in Practice 621-400-206).
* In the NYNEX Co. area the Guy Slide Rule, as described in 081-020-921NE Issue C 1968 is recommended for use.
Fig. 8--Pole LineGuying (<--Click here to view figure.)

A. GUYING CABLE LINES--PRACTICE 621-410-206

Where a pole supports more than one suspension strand, each strand should be guyed separately, or use local practices. Where this is not practical, see the above practice.

All corner poles should be guyed where the pull exceeds the following.

Maximum Allowable Pull for Unguyed Corners

Size of Suspension Strand	Maximum Allowable Pull (Ft.)
6M or 6.6M	3
10M	2
16M or larger	Any detectable amount

All unguyed corner poles must be set 1 foot inside the line of the pole lead and ground braced (key and crib). In most cases the stabilization of unguyed poles will require heavier class poles and increased depth of setting. Such cases will be detailed by the design engineer. See Practice 621-205-200 Section 10.03.F. "Determining Pole Class."

Suspension Strand Diminishing Points

At suspension strand diminishing points (for example, 16M to NOM), place a head guy away from the heavier strand. The size of guy would be equal to the difference in the strand sizes. In the case above, a 6M or 6.6M guy would be used.

B. GUYING INSULATED WIRES--PRACTICE 621-400-015

Guying of insulated wires at corners and dead ends is not required if the pull multiplied by the number of wires is less than the values given below. Where these values are exceeded, see the above practice for method of determining size of guy. (See Section 10.03.F. for definition of Pull.)

Maximum (Wires x Pull) Product for Unguyed Insulated Wires

Type of Wire	Sag	Span (Ft.)	Wires x Pull Product
C Rural Wire	Minimum	100-250	50
C Rural Wire	Minimum	250-450	40
C Rural Wire	Minimum	450-600	35
C or F Drop Wire	Recommended	Any	250
C or F Drop Wire	Minimum	Any	150
C, E, or F Multiple Drop Wire	Recommended	Any	75
C, E, or F Multiple Drop Wire	Minimum	Any	50

C. SIDEWALK ANCHOR GUYS--PRACTICE 621-410-220

Sidewalk anchor guys are used in guying over sidewalks or other pathways where right-of-way is insufficient to permit placing a guy with required clearance above the sidewalk.

Fig. 9--Sidewalk Anchor Guys (<--Click here to view figure.)

The size of strand required for a sidewalk guy is greater than that indicated by the Guy Rule: *

Indicated by Guy Rule	2.2M	6M	10M	12M	16M
Required for Sidewalk Guy	6M	10M	16M*	20M**	25M

*20M if height of guy attachment is 20 feet or less.

**22M if height of guy attachment is 18 feet or less.

Refer to 081-020-921NE for use of Guy Slide Rule.

The guy may consist of a single strand or of two strands having the combined strength indicated. For example, in the case of a 20M requirement, two lOM strands could be used.

Pipe sizes and lengths for sidewalk anchor guys are as follows:

Use 2-inch pipe for lengths up to those given below. For longer lengths, use 2-1/2 inch pipe.

Guy Size	6M	10M	12M	16M	20M	25M
Max. Length of 2-Inch Pipe (Ft.)	12	11	10	9	8	7

Pole size with sidewalk anchor guys are as follows:

The size of pole used with a sidewalk guy depends on the size of the guy and the lead/height ratio. The critical pole dimension is the ground-line circumference. The table below gives the class of a 30-foot southern pine pole.

Lead/Height	Size of Sidewalk Anchor Guy					
	6M	10M	12M	16M	20M	25M
	Class of 30-Ft SP Pole					
2/5	7	5	4	3	2	2
1/2	6	4	4	3	2	1
3/5	5	4	3	2	1	1
4/5	5	3	2	1	1	1
1/1	5	3	2	1	1	1

Note: Poles of other lengths may also be used provided their circumferences 6 feet from the butt are not less than those of the classes of 30-foot southern pine poles indicated above. See Practice 621-020-011 for pole dimensions.

D. GUY RODS AND ANCHORS--PRACTICES 621-415-200, THROUGH-215

Sizes of guy rods and types and sizes of anchors that can be used with each are given below.

GUY RODS Dia. (in.) Length (ft.) Marking* Type(s) avail.*	1/2 7 6M S	5/8 8 12M D	3/4 9 18M D, T	1 10 26M D, T	1-1/4 10 32M D, T
EXPANDING ANCHOR Dia. (in.)	6	8	10	12	12
B GUY ANCHOR	9	11	13 or 15	-	-

(Screw Type) Size No. and Nominal Dia. (in.)					
PLATE ANCHOR Type Dimensions (in.)	617 6 x 17	622 6 x 22	827 8 x 27	1040S 10 x 40	- -
PLANK ANCHOR Size	20 or 24	20 or 24	20 or 24	24	-

NET Co. Guy Slide Rule Versus 621 Practices

The 621 Series, of the Practices, give general rules for sizing strand, rods and anchors based on the number and size of strands terminating on a pole. These rules are intended to cover all situations. Use of these rules is permissible but may result in larger sizing than necessary.

The NET Co. Guy Slide Rule calculates the size of strand, rods and anchors on the basis of tension on the pole and will result in more accurate sizing than the broad rules given in the 621 Series. The use of the NET Co. Guy Slide Rule is described in New England Practice 081-020-921NE.

C Guy Anchors--Practice 621-415-204

Power Installed Screw Anchor

Soil Grade	Anchor Size and Type	Rod Size Marking	Eye Nut	Buying Load
1	5-Twin 4	1” 32M	Triple	Up to 32M
2	3-Twin 8	1” 32M	Triple	Up to 32M
2	6-Single 8	3/4” 18M	Double	Up to 18M
5	1-Twin 10	1” 32M	Triple	Up to 32M
5	4-Twin 8	3/4” 18M	Double	Up to 18M
5	7-Single 8	5/8” 12M	Double	Up to 12M
7	2-Twin 10	3/4” 18M	Double	Up to 18M

E. GROUNDING OR INSULATING GUYS--PRACTICES 621-405-201, 627-020-005, 919-120-560

* The exposure status (exposed or unexposed) of each telephone guy must be established.

All exposed guys must be either grounded or insulated.

Unexposed guys need not be grounded for protection reasons; however, connecting anchor guys to a grounded telephone cable strand is recommended, as it will lower the cable-to-ground impedance. This helps to reduce cable damage caused by lightning. It also helps to reduce telephone noise by increasing the effectiveness of the cable shield.

A guy is exposed if:

* It is attached to the same pole as open power conductors or spaced cable of any voltage.

* It crosses such power conductors.

* It is within 10 feet horizontally (and any distance vertically) of such power conductors.

* It is attached to the same pole as an exposed guy.
*In NET Co. area, all plant is considered as exposed.

In large Metropolitan Areas, such as Manhattan the outside plant is not considered exposed.

* It is attached to a pole carrying an isolated telephone cable (i.e., a length of aerial cable inserted in an open wire line) which is not effectively grounded.
Grounding is the preferred treatment for exposed guys, except for the following cases in which they must be insulated:

* Where exposed to trolley facilities.

* Within 1/2 mile of a power station (see Practice 919-120-560).

* Where electrolytic corrosion of anchors has occurred (unexposed guys, in this case, must be separated from the cable strand at the pole, and electrical connection through hardware must be avoided.)
A single anchor or ground rod ordinarily is not an adequate ground. Adequate grounding for telephone guys may be obtained through connection to any of the following:

* Vertical grounding conductor of power system multigrounded neutral (with permission of the power company).

* Suspension strand of grounded telephone cable.

* Common anchor rod with a power guy that is connected to the multigrounded neutral.

10.05 CABLE--SAGS AND TENSIONS

A. SUSPENSION STAND--PRACTICE 627-200-015

Galvanized suspension strand is available in two types. Class A is for general use under normal field conditions. Class C is for use where severe corrosion problems exist, e.g., in industrial or coastal areas.
The 6.6M strand is made of extra high-strength steel and is smaller, lighter, and less expensive than 6M strand. For guying, they are interchangeable. As suspension strands, however, they are limited to different span lengths, as shown on Section 10.06.*

The 2.2M strand should not be used to support aerial cable, except small cables in pole-to-building or building-to-building construction.

NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

Galvanized Strand

Size	Breaking Strength (Lb.)	Diameter (In.)	Weight (Lb./Ft.)
2.2M	2400	3/16	0.077
6M	6000	5/16	0.225
6.6M	6650	1/4	0.121
10M	11500	3/8	0.270
16M	18000	7/16	0.390
25M	25000	1/2	0.510

B. STRINGING TENSION FOR STRAND PRACTICES--627-210-018,919-565-400

The proper stringing tension is a compromise between high tension (which causes cable bowing and creeping) and low tension (which results in excessive sag and requires taller poles to obtain clearances). Recommended stringing tensions for supporting strand are shown in the following table.

Strand	Span Length (Ft)	Stringing Tension (Lb) at Temperature (°F)					
		0°	20°	40°	60°	80°	100°
6M	Up to 250	1550	1400	1250	1100	900	825
	250—450	1475	1350	1225	1100	1000	900
	Over 450	1375	1275	1175	1100	1025	950
6.6M	Up to 250	900	800	700	600	500	425
	250—450	850	750	675	600	525	475
	Over 450	775	700	650	600	550	525
10M	Up to 400	2675	2475	2275	2100	1900	1725
	Over 400	2600	2425	2250	2100	1925	1800
16M	Any	4425	4150	3875	3600	3325	3075
25M	Any	9125	8800	8400	8000	7625	7250

The proper stringing tension for self-supporting cable depends not only on temperature and span lengths, but also on cable weight. The tables for self-supporting cables are too voluminous to be included here. See Practice 627-700-011.

C. CABLE SAGS--PRACTICE 627-210-018

Cable sags at 100°F are shown below. They are based on the supporting strand being placed at the tensions given above.

To use the tables, locate the cable weight and span length. Where these lines intersect, the approximate sag is indicated. Example: A 0.41b/ft cable weight for a 200-foot span shows approximately 2-1/2 feet sag.

Cable sags at various degrees Fahrenheit are shown on tables in Practice 627-210-018. Those tables are too voluminous to be giver here. *

Sag data for self-supporting cable is too voluminous to be given here. Refer to Practice 627-700-011.

Cable weights are shown in Practices 626-101-005 and 626-101-010.
NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

Fig. 10--Cable Sag for 6M Strand at 100°F (<--Click here to view figure.)

Fig. 11--Cable Sag for 6.6M Strand at 100°F (<--Click here to view figure.)

Fig. 12--Cable Sag for 10M Strand at 100°F (<--Click here to view figure.)

Fig. 13--Cable Sag for 16M Strand at 100°F (<--Click here to view figure.)

Fig. 14--Cable Sag for 25M Strand at 100°F (<--Click here to view figure.)

10.06 CABLE--MAXIMUM SPAN LENGTHS

A. COPPER CONDUCTOR CABLES--PRACTICE 627-200-015

Span lengths are limited by the following factors:

(1) Strand tension shall not exceed 60 percent of breaking strength under storm loading conditions.

(2) Strand tension shall not exceed 70 percent of breaking strength with cable in place and a 300-pound load concentrated at midspan.

(3) Sag shall not exceed 10 feet at 60°F with no wind.

(4) The 6.6M strand tension shall not exceed 1660 pounds with cable in place at 60°F.

(5) For self-supporting cable the span length is limited by simultaneous application of items (3) and (4) above.

(6) May also be influenced by other utility companies on joint pole lines.

Maximum span lengths using recommended stringing tensions are shown below.*

MAXIMUM SPAN LENGTHS FOR SELF-SUPPORTING CABLE								
Gauge Code	Maximum Span Length (Feet)							
	Alpeth Sheath				Reinforced Sheath			
Pairs	19 BHBS	22 BHAS	24 BKMS	26 BKTS	19 BHBP	22 BHAP	24 BKMP	26 BKTP
6	650				475			
11	600				475			
16	500	600			425	475		
25	475	550	600	650	400	475	475	500
50	375	475	550	600	350	400	425	475
75		425	475	550		350	400	
100		375	425	500		300	375	425
150			375	425			340	375
200			350	400			310	350
300				350				315

NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

MAXIMUM ALLOWABLE SPAN LENGTHS — ALPETH AND STALPETH SHEATH, COPPER CONDUCTORS, MEDIUM LOADING AREA					
Cable Weight (Pounds/Foot)	Maximum Span Length (Feet)				
	6M	6.6M	10M	16M	25M
0.1	580	560	—	—	—
0.2	540	515	650	750	950
0.3	520	485	650	705	885
0.4	505	460	600	675	850
0.5	485	440	575	645	825
0.6	415	380	550	625	795
0.7	390	325	525	600	770
0.8	350	285	500	580	750
0.9	335	255	490	565	725
1.0	320	230	475	550	710
1.2	280	190	450	520	675
1.4	260	165	435	500	645
1.6	235	145	420	485	620
1.8	215	130	410	470	595
2.0	200	115	400	455	575
2.2	190	105	390	445	555
2.4	175	100	380	435	535
2.6	160	—	370	425	525
2.8	150	—	365	415	510
3.0	140	—	355	410	500
3.5	—	—	340	390	475
4.0	—	—	305	375	455
4.5	—	—	275	360	435
5.0	—	—	255	350	425

NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

MAXIMUM ALLOWABLE SPAN LENGTHS — ALPETH AND STALPETH SHEATH, COPPER CONDUCTORS, MEDIUM LOADING AREA					
Cable Weight (Pounds/Foot)	Maximum Span Length (Feet)				
	6M	6.6M	10M	16M	25M
0.1	580	560	—	—	—
0.2	540	515	650	750	950
0.3	520	485	650	705	885
0.4	505	460	600	675	850
0.5	485	440	575	645	825
0.6	415	380	550	625	795
0.7	390	325	525	600	770
0.8	350	285	500	580	750
0.9	335	255	490	565	725
1.0	320	230	475	550	710
1.2	280	190	450	520	675
1.4	260	165	435	500	645
1.6	235	145	420	485	620
1.8	215	130	410	470	595
2.0	200	115	400	455	575
2.2	190	105	390	445	555
2.4	175	100	380	435	535
2.6	160	—	370	425	525
2.8	150	—	365	415	510
3.0	140	—	355	410	500
3.5	—	—	340	390	475
4.0	—	—	305	375	455
4.5	—	—	275	360	435
5.0	—	—	255	350	425

NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

MAXIMUM ALLOWABLE SPAN LENGTHS — ALPETH AND STALPETH SHEATH, COPPER CONDUCTORS, HEAVY LOADING AREA					
Cable Weight (Pounds/Foot)	Maximum Span Length (Feet)				
	6M	6.6M	10M	16M	25M
0.1	400	560	—	—	—
0.2	375	515	650	750	950
0.3	335	485	650	705	885
0.4	320	460	600	675	850
0.5	290	440	575	645	825
0.6	280	380	550	625	795
0.7	260	325	525	600	770
0.8	250	285	500	580	750
0.9	230	255	490	565	725
1.0	220	230	475	550	710
1.2	200	190	450	520	675
1.4	185	165	435	500	645
1.6	175	145	420	485	620
1.8	160	130	405	470	595
2.0	150	115	385	455	575
2.2	145	105	360	445	555
2.4	135	100	345	435	535
2.6	130	—	325	425	525
2.8	125	—	315	415	510
3.0	115	—	300	410	500
3.5	—	—	270	380	475
4.0	—	—	245	345	435
4.5	—	—	230	320	405
5.0	—	—	215	300	375

NOTE: *Refer to BR 627-070-015 (Issue 2, 11/89).
Refer to BR 918-117-090 (Issue 6, 12/89).
Also refer to Section 11 of the Manual.

B. LIGHTGUIDE CABLES PRACTICES--627-320-011,-205,-206,920-400-300

Aerial cable is exposed to the potential of damage by a variety of agents such as rodent attack, target practice, auto accidents, and fire. In view of the high-circuit capacity of lightwave transmission systems, alternatives should be carefully evaluated before the decision to place lightguide cable in aerial plant is made. In general, aerial lightguide cable should be used only if the alternative choices are prohibitive. If there is no other alternative, placing aerial lightguide cable has the following restrictions:

* Because the sag of a lightguide cable span is small, a new strand for the lightguide cable should occupy the uppermost communication space on the pole line. Construction of aerial lightguide cable routes on joint-use pole line is not

recommended unless sufficient space is available to provide the required vertical clearance from power wires.
* Because lightguide cable weighs very little, the sag in an aerial lightguide cable span is relatively small--not much more than the sag of the strand alone. Increasing the sag by stringing the strand at lower-than-recommended tension causes increased fiber stresses under storm loading and is not recommended.

* If there are existing aerial cables on the pole line, do not attempt to sag the lightguide cable to the same sag as the other cable(s).
Maximum permissible span lengths for lightguide cable are as follows:

MAXIMUM PERMISSIBLE SPANS "LIGHTPACK" CABLES (NOTES 1 AND 2)

Storm-Loading Region	Suspension Strand				
	6.6M	6M	10M	16M	25M
Heavy	200	300	400	600	1000
Medium	400	650	800	1200	1500
Light	350	600	800	1200	1500

RIBBON-TYPE CABLES (NOTE 1)

Storm-Loading Region	Suspension Strand				
	6.6M	6M	10M	16M	25M
Heavy	100	150	250	350	600
Medium	150	250	400	600	1100
Light	150	300	400	600	1200

Notes:
1. All span lengths are in feet.
2. Cable rated at 300 pounds maximum tension must be free of tension when lashed.

Suspension strand and stringing tensions are covered in Practice 627-210-018.

C. SPECIAL LONG-SPAN DESIGN--PRACTICES 627-370-200,-205,919-565-450
Where the required span length for aerial cable exceeds the limits indicated above, the following alternatives are possible:
(1) Where the span length is sag-limited, place the strand at the recommended stringing tension and violate the 10-foot sag limitation.

(2) Where the span is storm load tension-limited, place the strand at a lower stringing tension.

(3) Place a catenary suspension strand (see below) above the regular cable suspension strand.

Fig. 15--Special Long-Span Design (<--Click here to view figure.)

Sags and tensions for these special designs must be calculated since they are not tabulated. Practice 919-565-450 contains instructions for writing computer programs to make the calculations.

10.07 WIRE

The maximum span lengths, sag, and tension of wire is shown in the following practices.
917-534-100 Multiple Line Wire

917-534-100 C Rural Wire
Guying insulated wires is covered in Practice 621-400-015.

10.08 BIBLIOGRAPHY

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621-020-111	Dimensions and Weights of Poles and Stubs
621-205-200	Erecting Poles and Stubs
621-205-211	Placing Pole Braces and H Fixtures
621-400-011	Guying--Definitions
621-400-013	Guying--Sizes of Guys
621-400-015	Guying--Insulated Wires
621-405-201	Guying--Methods of Insulating
621-410-206	Guying--Aerial Cable Lines
621-410-220	Guying--Sidewalk Anchor Guys
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Section 25	General Loading Requirements and Maps